CLAIMS

What is claimed is:

1. A coaxial conductive yarn structure comprising:

(a) a first conductive yarn extending in a first direction and having a plurality of first conductive strands being twisted together;

(b) a second conductive yarn having a plurality of second conductive strands being twisted together, the second conductive yarn being wrapped around the first conductive yarn in a second direction transverse to the first direction and substantially covering the first conductive yarn; and

(c) at least one insulating layer for electrically isolating the first and second conductive yarns from each other.

2. The coaxial conductive yarn structure of claim 1 wherein the first and second conductive strands each comprise a conductive material selected from a group including metals, alloys, and conductive polymers.

3. The coaxial conductive yarn structure of claim 1 wherein the insulating layer comprises an electrically insulating material selected from a group including polyvinylchloride; rubber; rubber forming polymers, including polyisoprene, polybutadiene, polychloroprene, and polyisobutylene; polyesters; polyolefins; and polyamides.

4. The coaxial conductive yarn structure of claim 1 wherein the insulating layer is substantially uniform in thickness.

5. A braided coaxial conductive yarn structure comprising:

(a) a first conductive yarn extending in a first direction and having a plurality of first conductive strands being twisted together to form a single conductor;

(b) a conductive braid surrounding the first conductive yarn; and

(c) at least one insulating layer for electrically isolating the first conductive yarn and the conductive braid from each other.

6. A twisted pair conductive yarn structure comprising:

(a) a first conductive yarn having a plurality of conductive strands being twisted together;

(b) a second conductive yarn having a plurality of conductive strands being twisted together, the second conductive yarn being twisted together with the first conductive yarn to form a helical structure; and

(c) at least one insulating layer surrounding at least one of the conductive yarns for electrically isolating the first and second conductive yarns from each other.

7. The twisted pair conductive yarn structure of claim 6 wherein the conductive strands comprise a conductive material selected from a group including metals, alloys, and conductive polymers.

8. The twisted pair conductive yarn structure of claim 6 wherein the insulating layer comprises an electrically insulating material selected from a group including polyvinylchloride; rubber; rubber forming

polymers, including polyisoprene, polybutadiene, polychloroprene, and polyisobutylene; polyesters; polyolefins; and polyamides.

9. The twisted pair conductive yarn structure of claim 6 wherein the insulating layer is substantially uniform in thickness.

10. A woven electrical network comprising:

(a) a first coaxial conductive yarn structure being woven into a fabric in a first direction, the first coaxial conductive yarn structure including an inner conductive yarn, an outer conductive yarn being wound around the inner conductive yarn in a second direction transverse to the first direction and substantially covering the inner conductive yarn, and at least one insulating layer for electrically isolating the inner and outer conductive yarns from each other, wherein the outer conductive yarn is connected to ground;

(b) a second coaxial conductive yarn structure being woven into the fabric in the first direction and being spaced from the first coaxial conductive yarn structure, the second coaxial conductive yarn structure including an inner conductive yarn, an outer conductive yarn being wound around the inner conductive yarn in a second direction transverse to the first direction and substantially covering the inner conductive yarn, and an insulating layer for electrically isolating the inner and outer conductive yarns from each other, wherein the outer conductive yarn is connected to ground; and

(c) an AC signal source being connected to the inner conductive yarn of the first coaxial conductive yarn structure for sending an AC signal over the first coaxial conductive yarn structure, wherein the grounded outer conductive yarns of the first and second coaxial conductive yarn structures block electromagnetic fields emanating from the inner conductive yarn of the first coaxial conductive yarn structure and thereby reduce crosstalk between the first and second coaxial conductive yarn structures.

11. The woven electrical network of claim 10 wherein the inner conductive yarns of the first and second coaxial conductive yarn structures each include a plurality of conductive strands being twisted together with each other.

12. The woven electrical network of claim 10 wherein the outer conductive yarns of the first and second coaxial conductive yarn structures each include a plurality of strands being twisted together with each other.

13. The woven electrical network of claim 12 wherein the strands of the outer and inner conductive yarns each comprise a conductive material selected from a group including metals, alloys, and conductive polymers.

14. The woven electrical network of claim 10 wherein the insulating layers of the first and second coaxial yarn structures comprise an electrically insulating material selected from a group including polyvinylchloride; rubber; rubber forming polymers, including polyisoprene, polybutadiene,

polychloroprene, and polyisobutylene; polyesters; polyolefins; and polyamides.

15. The woven electrical network of claim 10 wherein the insulating layers of the first and second coaxial conductive yarn structures are substantially uniform in thickness.

16. The woven electrical network of claim 10 wherein the first and second coaxial conductive yarn structures are spaced from each other in the fabric by a predetermined distance.

17. The woven electrical network of claim 16 wherein the predetermined distance ranges from about one hundredth of an inch to no more than about one inch.

18. The woven electrical network of claim 10 comprising a plurality of nonconductive yarns being woven in the fabric with the first and second coaxial conductive yarn structures.

19. The woven electrical network of claim 18 wherein the nonconductive yarns each comprise a material selected from a group including polyamides, including nylon; polyurethane; polyimides; polyesters; acrylics, acetate materials; viscose materials; and natural fibers, including wool, silk, and cotton.

20. The woven electrical network of claim 10 wherein the first and second coaxial conductive yarn structures comprise warp yarns.

21. The woven electrical network of claim 10 wherein the first and second coaxial conductive yarn structures comprise weft yarns.

22. A woven electrical network comprising:

(a) a first twisted pair conductive yarn structure being woven into a fabric in a first direction, the first twisted pair conductive yarn structure including first and second conductive yarns and at least one insulating layer for electrically isolating the first and second conductive yarns from each other, the first and second conductive yarns being twisted together to form a helical structure, the second conductive yarn being connected to ground;

(b) a second twisted pair conductive yarn structure being woven into the fabric in the first direction and being spaced from the first twisted pair yarn structure, the second twisted pair conductive yarn structure including first and second conductive yarns and at least one insulating layer for electrically isolating the first and second conductive yarns from each other, the first and second conductive yarns being twisted together to form a helical structure, the second conductive yarn being connected to ground; and

(c) an AC signal source being connected to the first conductive yarn of the first twisted pair conductive yarn structure for sending an AC signal over the first twisted pair conductive yarn structure, wherein the grounded second conductive yarns of the first and second twisted pair conductive yarn structures block electromagnetic fields emanating from the first conductive yarn of

the first twisted pair conductive yarn structure and thereby reduce crosstalk between the first and second twisted pair conductive yarn structures.

23. The woven electrical network of claim 22 wherein conductive yarns of the first and second twisted pair conductive yarn structures each include a plurality of conductive strands being twisted together with each other.

24. The woven electrical network of claim 23 wherein the conductive strands comprise a conductive material selected from a group including metals, alloys, and conductive polymers.

25. The woven electrical network of claim 22 wherein the insulating layers comprise an electrically insulating material selected from a group including polyvinylchloride; rubber; rubber forming polymers, including polyisoprene, polybutadiene, polychloroprene, and polyisobutylene; polyesters; polyolefins; and polyamides.

26. The woven electrical network of claim 22 wherein the insulating layers are substantially uniform in thickness.

27. The woven electrical network of claim 22 wherein the first and second twisted pair conductive yarn structures are spaced from each other in the fabric by a predetermined distance.

28. The woven electrical network of claim 27 wherein the predetermined distances ranges from about one hundredth of an inch to no more than about one inch.

29. The woven electrical network of claim 22 comprising a plurality of nonconductive yarns being woven in the fabric with the twisted pair conductive yarn structures.

30. The woven electrical network of claim 29 wherein the nonconductive yarns each comprise a material selected from a group including polyamides, including nylon; polyurethane; polyimides; polyesters; acrylics, acetate materials; viscose materials; and natural fibers, including wool, silk, and cotton.

31. The woven electrical network of claim 22 wherein the first and second twisted pair conductive yarn structures comprise warp yarns.

32. The woven electrical network of claim 22 wherein the first and second twisted pair conductive yarn structures comprise weft yarns.

33. A woven electrical network comprising:

(a) a twisted pair conductive yarn structure being woven into a fabric in a first direction, the twisted pair conductive yarn structure including first and second conductive yarns and at least one insulating layer for electrically isolating the first and second conductive yarns from each other, the first and second conductive yarns being twisted together to form a helical structure; and

(b) an AC signal source connected to the first and second conductive yarns for oppositely driving the first and second conductive yarns with equal but opposite AC signals and achieving common mode noise rejection.

34. A fabric-based signal transmission system for communicating electrical signals between circuit elements in a fabric-based electric circuit, the fabric-based signal transmission system comprising:

(a) a plurality of nonconductive threads extending in a first direction in a fabric; and

(b) first and second conductive threads, each conductive thread including an inner conductor and an outer insulating layer surrounding the inner conductor, the first and second conductive threads extending in a second direction substantially perpendicular to the first direction and including a first region wherein the first and second conductive threads are twisted together and around adjacent nonconductive threads extending in the first direction to form a leno weave.

35. The fabric-based signal transmission system of claim 34 wherein the first direction comprises a warp direction and the second direction comprises a weft direction.

36. The fabric-based signal transmission system of claim 34 wherein the first direction comprises a weft direction and the second direction comprises a warp direction.

37. The fabric-based signal transmission system of claim 34 wherein, in the first region, the first conductive thread is always on a first side of each of the adjacent nonconductive threads and the second conductive thread is always on a second side of each of the adjacent nonconductive threads, thereby forming a bottom doup leno weave.

38. The fabric-based signal transmission system of claim 34 wherein, in the first region, the first conductive thread alternates between first and second sides of the adjacent nonconductive threads and the second conductive thread alternates between the second and first sides of the adjacent nonconductive threads.

39. The fabric-based signal transmission system of claim 34 comprising an alternating current (AC) signal source and a ground, wherein the AC signal source is connected to the inner conductor of the first conductive thread and the ground is connected to the inner conductor of the second conductive thread.

40. The fabric-based signal transmission system of claim 34 comprising an AC signal source, wherein the AC signal source is connected to the inner conductors of the first and second conductive threads to oppositely drive the inner conductors of the first and second conductive threads.

41. The fabric-based signal transmission system of claim 34 comprising a second region in the fabric wherein the first and second conductive threads are substantially parallel to each other and are woven with the nonconductive threads in a manner to facilitate electrical connection and disconnection with the first and second conductive threads.

42. The fabric-based signal transmission system of claim 34 comprising a second region in the fabric wherein the first and second conductive threads are substantially parallel to each other and are floating with respect to the nonconductive threads to facilitate interconnection or disconnection with electronic devices.

43. The fabric-based signal transmission system of claim 34 wherein the first and second conductive threads form a twisted pair structure.

44. The fabric-based signal transmission system of claim 34 comprising a third conductive thread including an inner conductor and an insulating layer surrounding the inner conductor, the third conductive thread being leno-woven in the first region of the fabric with the first and second conductive threads to form a coaxial structure.

45. The fabric-based signal transmission system of claim 44 wherein the first and third conductive threads are connected to ground and the second conductive thread is connected to a signal source.

46. The fabric-based signal transmission system of claim 44 comprising a second region in the fabric wherein the first, second, and third conductive threads are substantially parallel to each other and are plain woven with the nonconductive threads in a manner to facilitate interconnection and disconnection with electronic devices.

47. The fabric-based signal transmission system of claim 44 comprising a second region in the fabric wherein the first, second, and third conductive threads are substantially parallel to each other and are floating with respect to the nonconductive threads to facilitate interconnection or disconnection of the conductive threads with electronic devices.

48. A fabric-based signal transmission system for communicating electrical signals between circuit elements in a fabric-based electric circuit, the fabric-based signal transmission system comprising:

(a) a plurality of nonconductive threads being knitted together to form a fabric;

(b) a first conductive thread being knitted in the fabric and interlocking with the nonconductive threads, the first conductive thread having an inner conductor and an outer insulating layer surrounding the inner conductor; and

(c) a second conductive thread being knitted in the fabric and interlocking with the first conductive thread, the second conductive thread including an inner conductor and an outer conductive layer surrounding the inner conductor.

49. The fabric-based signal transmission system of claim 48 wherein the first conductive thread is connected to a signal source and the second conductive thread is connected to ground.

50. The fabric-based signal transmission system of claim 48 comprising an AC signal source connected to the inner conductors of the first and second conductive threads for oppositely driving the first and second conductive threads with equal but opposite AC signals and achieving common mode noise reduction on the first and second conductive threads.

51. The fabric-based signal transmission system of claim 48 wherein the first and second conductive threads are warp-knitted in the fabric.

52. The fabric-based signal transmission system of claim 48 wherein the first and second conductive threads are weft-knitted in the fabric.

53. The fabric-based signal transmission system of claim 48 wherein the first and second conductive threads form a twisted pair structure.

54. The fabric-based signal transmission system of claim 48 further comprising a third conductive thread being knitted in the fabric and interlocking with the second conductive thread, the third conductive thread including an inner conductor and an outer insulating layer surrounding the inner conductor, wherein the first, second, and third conductive threads form a coaxial structure.

55. The fabric-based signal transmission system of claim 54 wherein the first and third conductive threads are connected to ground and the second conductive thread is connected to a signal source.

56. The fabric-based signal transmission system of claim 54 wherein the first, second, and third conductive threads are warp-knitted in the fabric.

57. The fabric-based signal transmission system of claim 54 wherein the first, second, and third conductive threads are weft-knitted in the fabric.

58. A fabric-based signal transmission system for communicating electrical signals between circuit elements in a fabric-based electric circuit, the fabric-based signal transmission system comprising:

(a) a plurality of nonconductive threads being knitted together to form a fabric; and

(b) a coaxial conductive yarn structure being knitted in the fabric and interlocking with the nonconductive threads, the coaxial conductive yarn structure having an a plurality of inner conductive strands being twisted together, an insulating layer surrounding

the inner conductive strands, and an outer conductor surrounding the insulating layer.

59. The fabric-based signal transmission system of claim 58 comprising an alternating current (AC) signal source and a ground, wherein the AC signal source is connected to the inner conductive strands of the coaxial conductive yarn structure and the outer conductor is connected to the ground.

60. The fabric-based signal transmission system of claim 58 wherein the coaxial conductive yarn structure is warp-knitted in the fabric.

61. The fabric-based signal transmission system of claim 58 wherein the coaxial conductive yarn structure is weft-knitted in the fabric.

62. The fabric-based signal transmission system of claim 58 wherein the outer conductor includes a plurality of conductive strands being braided around the insulating layer.

63. A fabric-based signal transmission system for communicating electrical signals between circuit elements in a fabric-based electric circuit, the fabric-based signal transmission system comprising:

(a) a plurality of nonconductive threads being knitted together to form a fabric; and

(b) a twisted pair conductive yarn structure being knitted in the fabric and interlocking with the nonconductive threads, the twisted pair conductive yarn structure including first and second conductive yarns, each conductive yarn including a plurality of conductive strands being twisted together and an outer insulating layer

surrounding the conductive strands, the first and second conductive yarns being twisted together.

64. The fabric-based signal transmission system of claim 63 comprising an AC signal source and a ground, wherein the first conductive yarn is connected to the AC signal source and the second conductive yarn is connected to ground.

65. The fabric-based signal transmission system of claim 63 comprising an AC signal source coupled to the first and second conductive yarns for oppositely driving the first and second conductive yarns with equal but opposite AC signals and achieving common mode noise rejection.

66. The fabric-based signal transmission system of claim 63 wherein the twisted pair conductive yarn structure is warp-knitted in the fabric.

67. The fabric-based signal transmission system of claim 63 wherein the twisted pair conductive yarn structure is weft-knitted in the fabric.

68. A fabric-based signal transmission system comprising:

(a) a plurality of conductive yarn structures being braided to form a fabric having braided conductive yarn structure, each conductive yarn structure including a plurality of strands being twisted together to form a single conductor and an insulating layer surrounding the conductor; and

(b) an electronic device being connected to the conductor of one of the conductive yarn structures.

69. The fabric-based signal transmission system of claim 68 wherein each of the conductive yarn structures comprises a coaxial conductive yarn structure having a conductor surrounding the insulating layer.

70. The fabric-based signal transmission system of claim 69 wherein the conductor is wound around the insulating layer.

71. The fabric-based signal transmission system of claim 69 wherein each coaxial conductive yarn structure includes a plurality of conductors being braided around the insulating layer.

72. The fabric-based signal transmission system of claim 68 wherein each conductive yarn structure comprises a twisted pair conductive yarn structure including a second yarn being twisted together with the first yarn.

73. The fabric-based signal transmission system of claim 68 wherein the braided conductive yarn structure includes a hollow core and the electrical device is located in the core.

74. The fabric-based signal transmission system of claim 73 wherein the electrical device is not visible from a surface of the fabric.

75. The fabric-based signal transmission system of claim 68 comprising a plurality of different electronic devices connected to the conductive yarn structures.

76. A woven electrical network including at least one fabric-based signal transmission system as claimed in claim 68.

77. A knitted electrical network including at least one fabric-based signal transmission system as claimed in claim 68.

78. A method for making a fabric-based signal transmission system, the method comprising:

(a) weaving a plurality of nonconductive threads together to form a fabric;

(b) twisting first and second insulated conductive threads together; and

(c) while twisting the first and second insulated conductive threads together, leno-weaving the first and second conductive threads into a first region of the fabric.

79. The method of claim 78 wherein performing steps (b) and (c) includes weaving the first and second conductive threads into the fabric in a first direction while simultaneously twisting the threads around adjacent nonconductive threads extending in a second direction in the fabric transverse to the first direction

80. The method of claim 78 wherein performing step (c) includes using a Jacquard loom equipped with leno headles.

81. The method of claim 78 wherein leno-weaving the first and second conductive threads into the fabric includes interlocking the first and second conductive threads with the nonconductive threads such that, in the first region, the first conductive thread is always on a first side of each of the nonconductive threads and the second conductive thread is always on a second side of each of the nonconductive threads, thereby forming a bottom doup leno weave.

82. The method of claim 78 wherein leno-weaving the first and second conductive threads into the fabric includes interlocking the first and second conductive threads with the nonconductive threads such that, in the first region, the first conductive thread alternates between first and second sides of adjacent nonconductive threads and the second conductive thread alternates between the second and first sides of the adjacent nonconductive threads.

83. The method of claim 78 comprising, in a second region of the fabric, ceasing steps (b) and (c) and weaving the first and second insulated conductive threads into the fabric.

84. The method of claim 83 wherein weaving the first and second insulated conductive threads into the fabric includes skipping at least one of the nonconductive threads and thereby creating a float to facilitate interconnection or disconnection with electrical devices.

85. The method of claim 78 wherein the first and second conductive threads form a twisted pair structure.

86. The method of claim 78 comprising, concurrently with step (c), leno weaving a third conductive thread into the fabric with the first and second conductive threads to form a coaxial structure.

87. A method for making a conductive thread structure with improved signal integrity characteristics, the method comprising:

(a) interlocking a plurality of conductive threads with nonconductive threads to form a fabric;

(b) while interlocking the conductive threads with the nonconductive threads, interlocking the conductive threads with each other to form a conductive structure;

(c) connecting a first conductive thread of the conductive structure to a signal source; and

(d) connecting at least one thread of the conductive structure to ground.

88. The method of claim 87 wherein interlocking a plurality of conductive threads with nonconductive threads includes weaving the conductive threads with the nonconductive threads.

89. The method of claim 88 wherein weaving the conductive threads with the nonconductive threads includes leno weaving the conductive threads with the nonconductive threads.

90. The method of claim 87 wherein interlocking the conductive threads with the nonconductive threads includes knitting the conductive threads to the nonconductive threads.

91. The method of claim 90 wherein knitting the conductive threads to the nonconductive threads includes warp knitting the conductive threads to the nonconductive threads.

92. The method of claim 90 wherein knitting the conductive threads to the nonconductive threads includes weft knitting the conductive threads to the nonconductive threads.

93. The method of claim 87 wherein interlocking the conductive threads with each other includes twisting two conductive threads together to form a twisted pair structure.

94. The method of claim 87 wherein interlocking the conductive threads with each other includes twisting three conductive threads together to form a coaxial structure.

95. The method of claim 87 wherein interlocking conductive threads with each other includes knitting two conductive threads to each other to form a twisted pair structure.

96. The method of claim 87 wherein interlocking conductive threads with each other includes knitting three conductive threads to each other to form a coaxial structure.